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F4H H12B
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INT CL[5] A21B , A21C , F25D

(54) **A bread baking process and apparatus**

(57) Dough is formed in a dough mixer (10) and cut by a dough divider (12) into dough pieces. The dough pieces are delivered on a conveyor (14) to a dough moulding machine (16). Air is blown onto the dough pieces on the conveyor (14) to form a thin outer skin on each dough piece. The dough pieces pass from the moulding machine (16) through an initial prover (18) through a panner moulder (20) to a tinning station (22) in which they are discharged into tins. Then the tins with dough pass through a final prover (24) and an oven (26) to form bread loaves. Downstream of the oven (26) the bread is removed from the tins and passed through a bread cooler (36) in which the bread is rapidly cooled by passing a high volume of cooling air at relatively high humidity through the cooler (36). The hot tins are delivered to a tin cooler (32) having a carousel on which the tins cool naturally in air for a preset time period. Cooled tins are returned to the timing station (22) via a tin greaser (34).

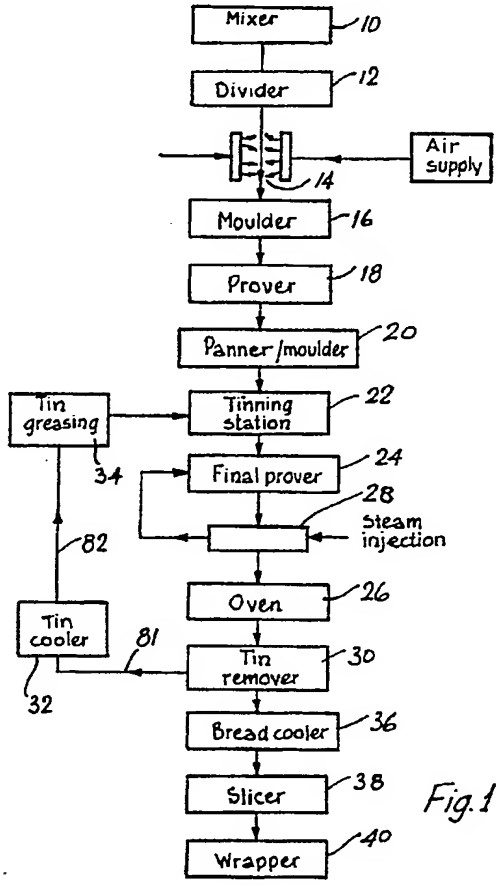

Fig.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

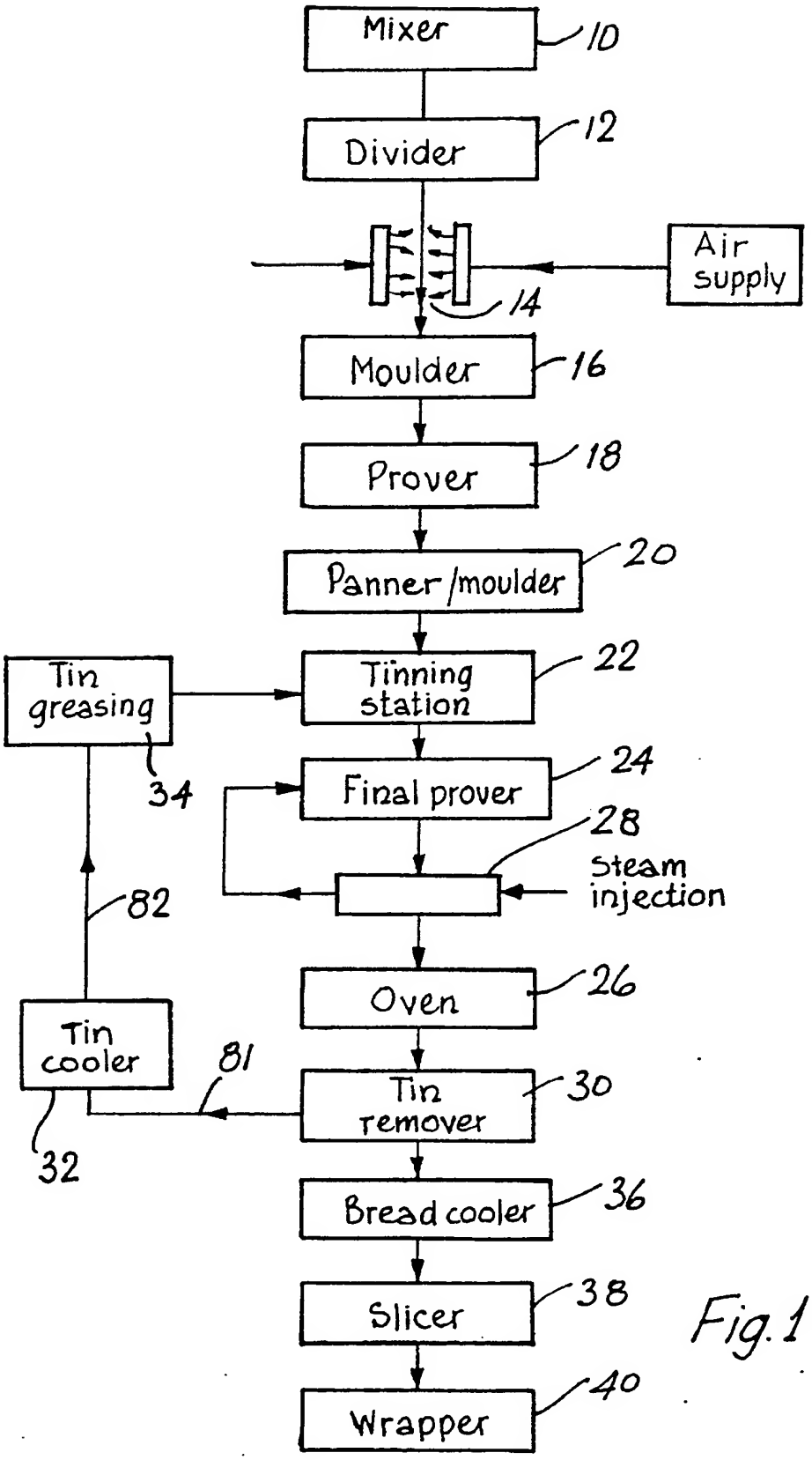
Mixer
10
Divider
12
Air supply
14
Moulder
16
Prover
18
Panner /moulder
20
Tin greasing
Tinning station
22
34
Final prover
24
28
Steam injection
82
Oven
26
Tin cooler
81
Tin remover
30
32
Bread cooler
36
Slicer
38
Wrapper
40

Fig. 1

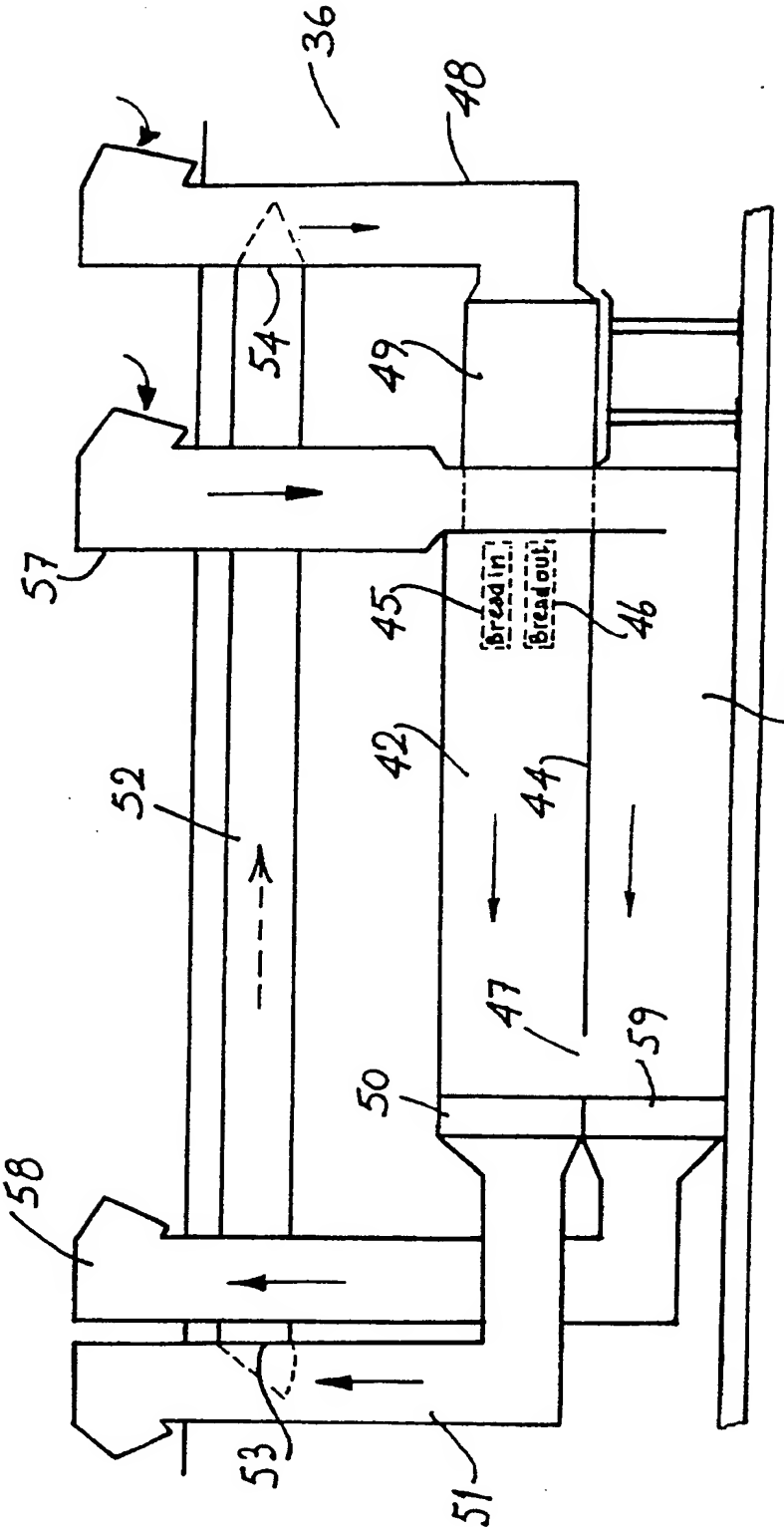

Fig. 2

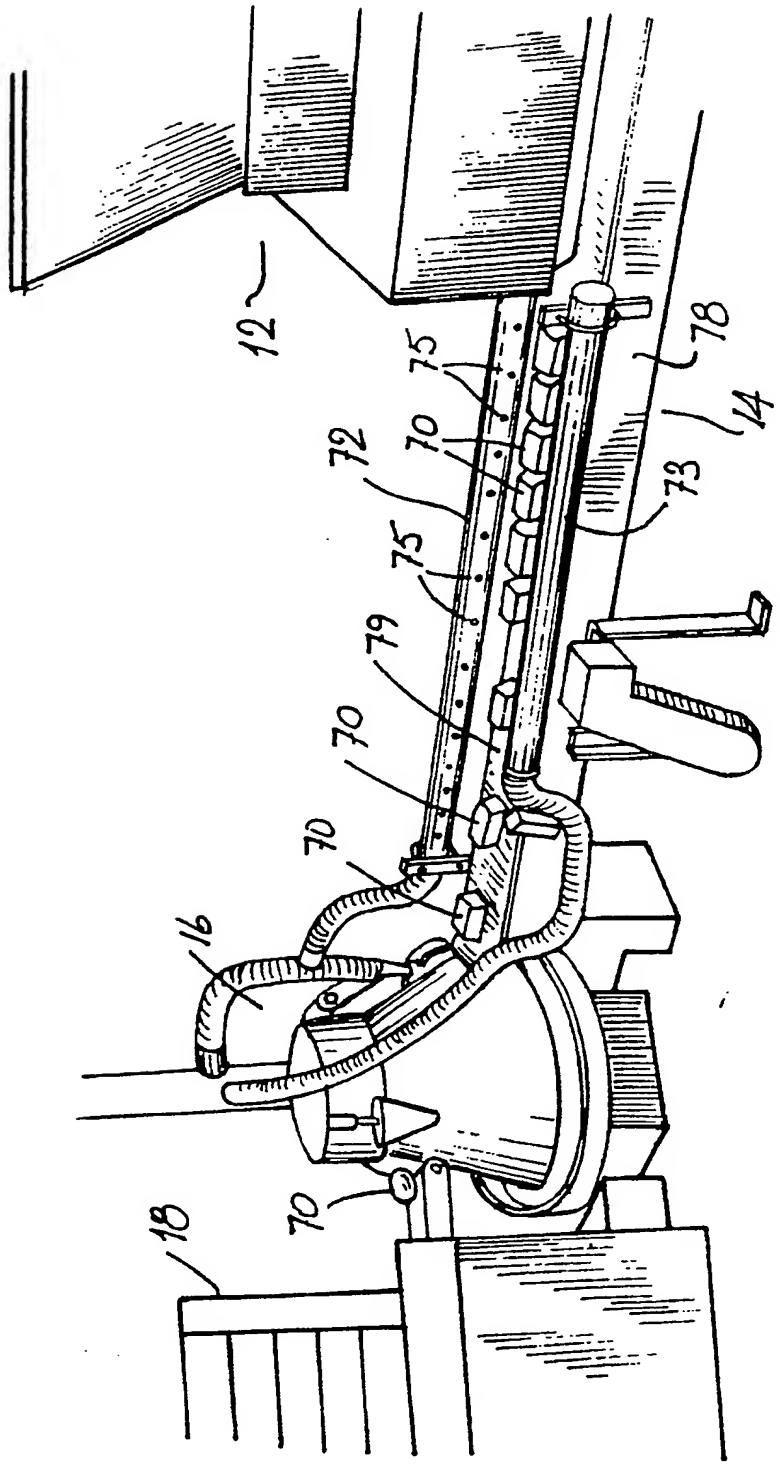

Fig.3

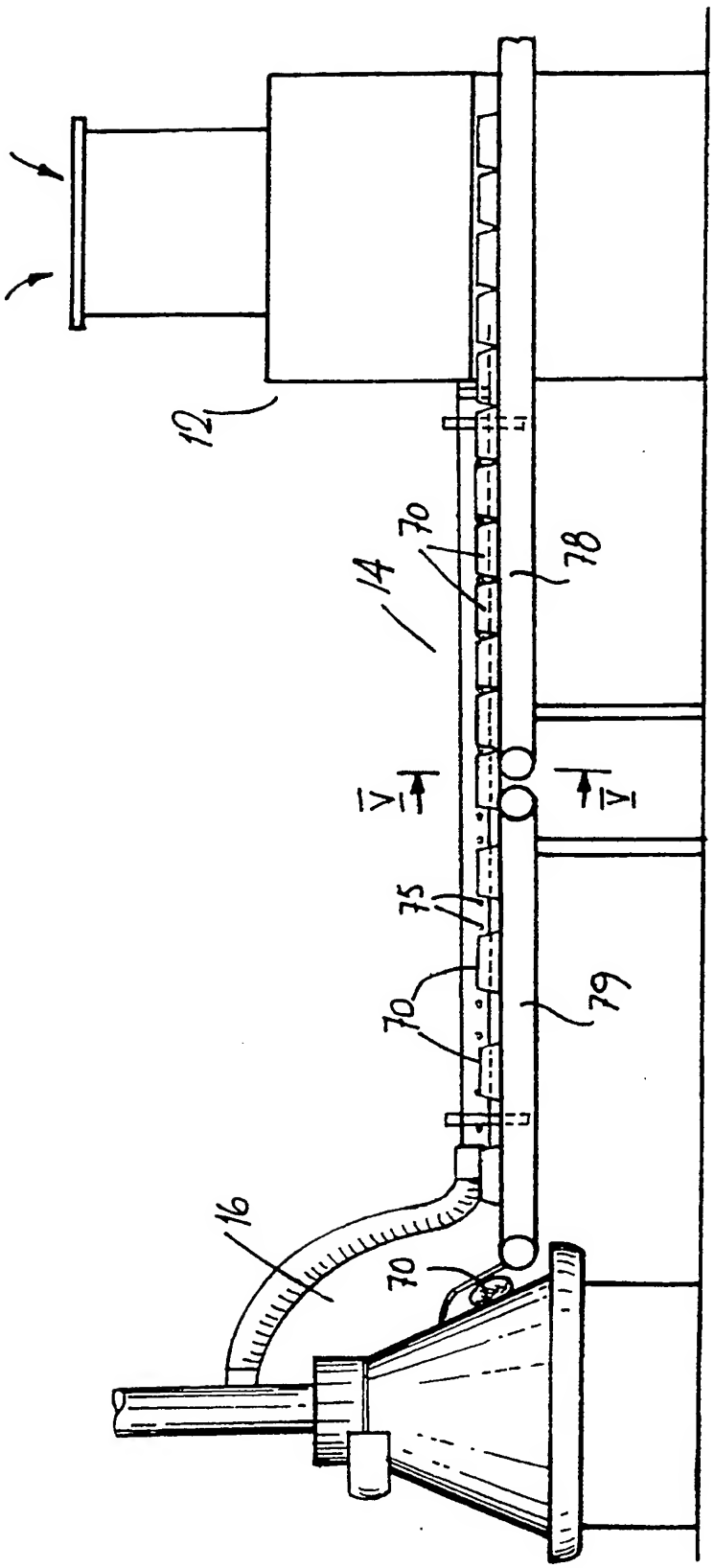

Fig.4

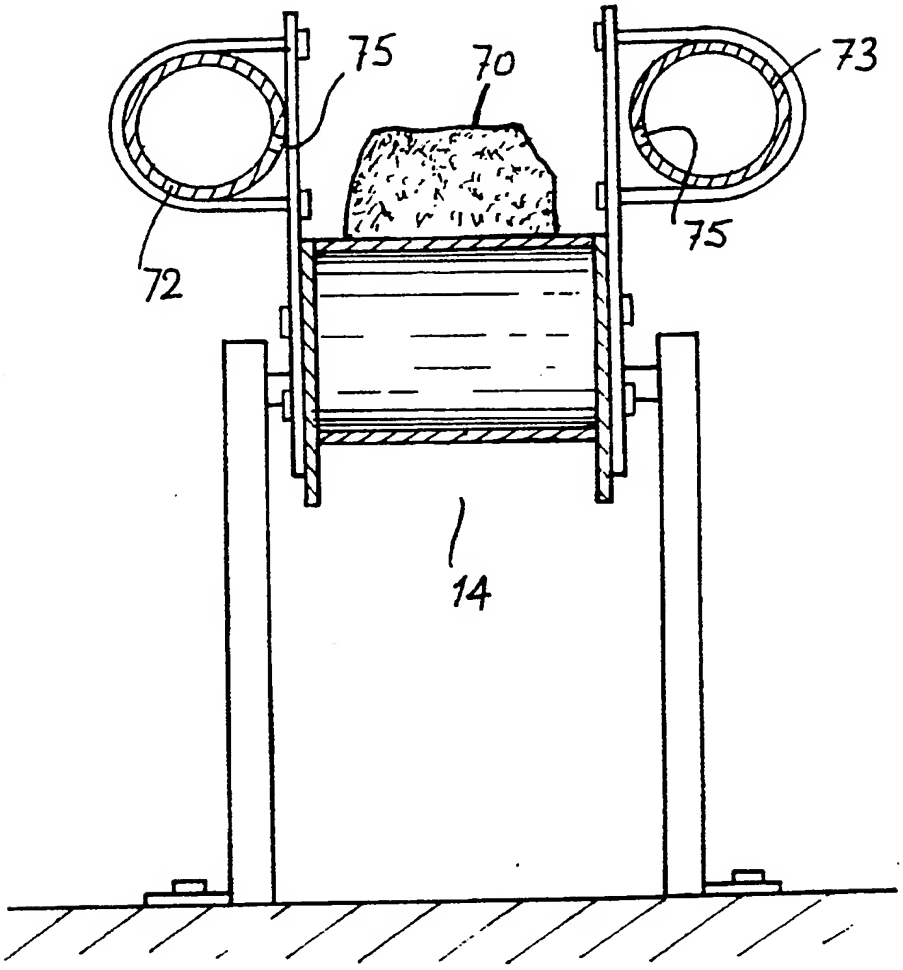

Fig. 5

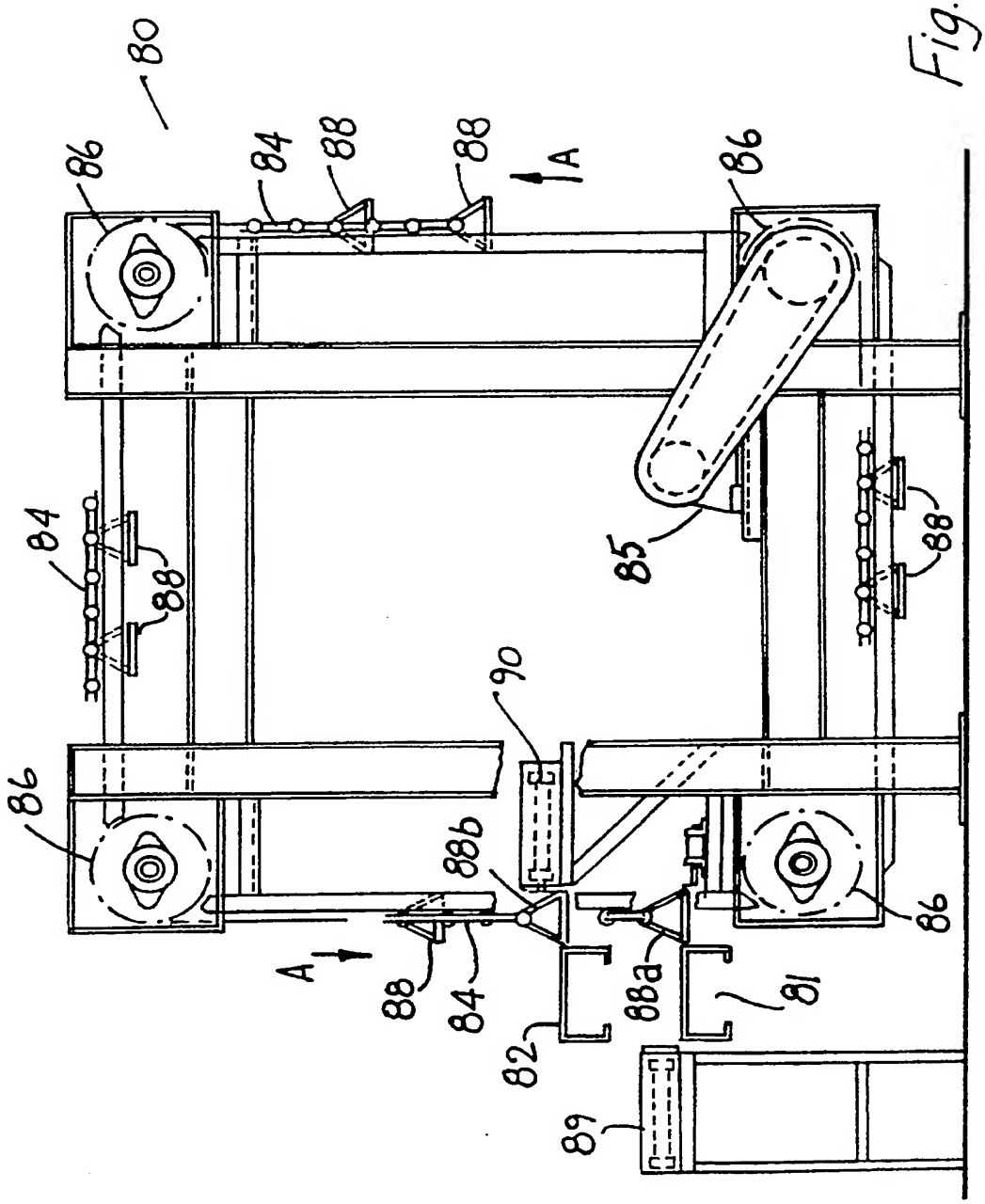

Fig.6

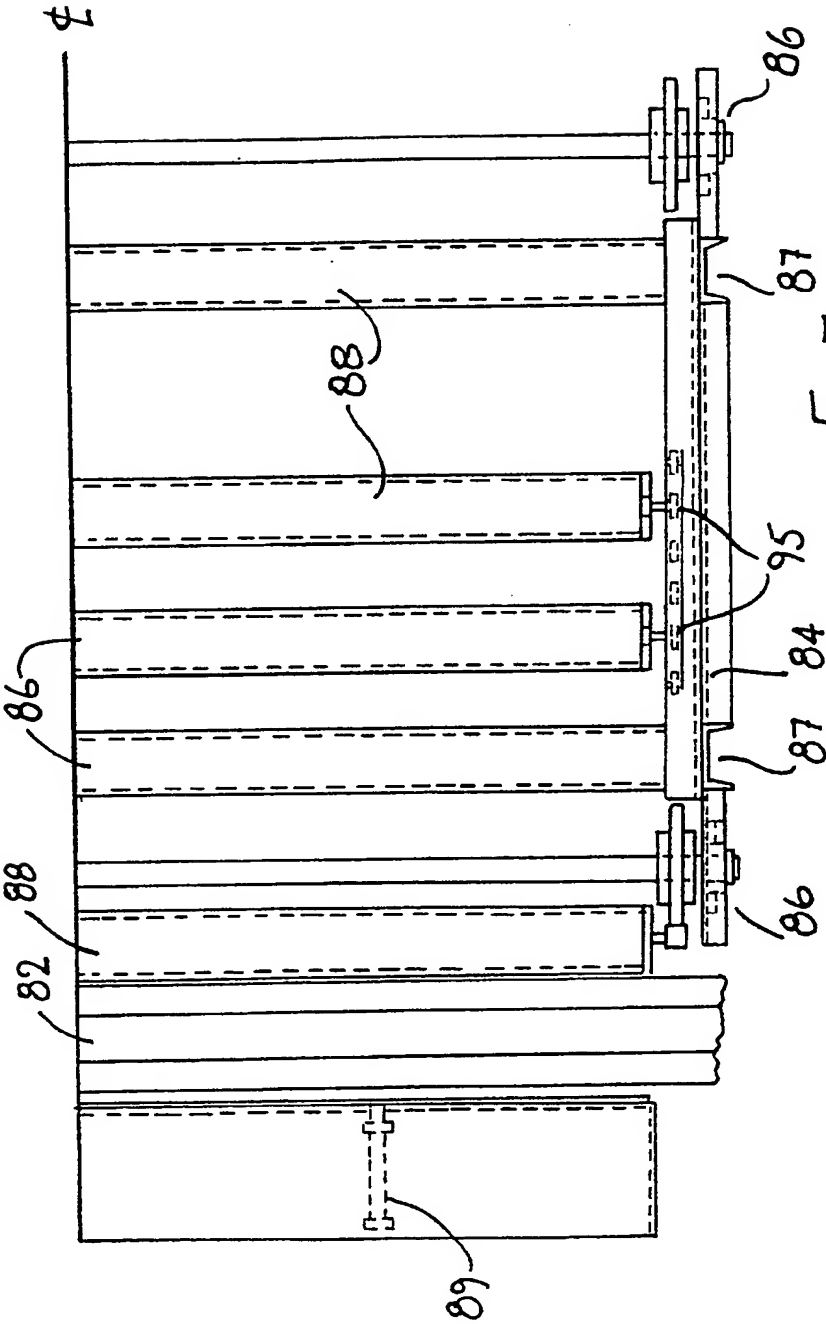

Fig. 7

"A Bread Baking Process and Apparatus"

This invention relates to a bread baking process and apparatus, in particular a continuous bread baking process and apparatus.

According to the invention there is provided a bread baking process comprising the steps of:-

(a) delivering measured quantities of ingredient materials to a dough mixer and mixing the ingredient materials to form a batch quantity of dough;

(b) delivering the dough to a dough divider and dividing the batch quantity of dough into dough pieces of a preset desirable size;

(c) conveying the dough pieces to a dough piece moulding machine and shaping each dough piece in the moulding machine;

(d) discharging the dough pieces from the moulding machine to an initial prover, maintaining the prover at a preset desirable temperature and humidity during through passage of the dough pieces;

(e) passing the dough pieces through a panner-moulder and discharging each dough piece into a tin at a tinning station;

(f) delivering the tins through a final prover, maintaining air within the final prover at a preset desirable temperature and humidity during through passage of the tins;

(g) conveying the tins through an oven to bake the dough at a preselected temperature for a preset time period to form bread loaves;

(h) removing the bread from the tins downstream of the oven; and

(i) cooling the bread by passing the bread through a two-stage cooler having a primary stage and a secondary stage, rapidly cooling the bread in the primary stage of the cooler by passing a high volume of cooling air at relatively high humidity through the primary stage, a cooling air inlet being provided adjacent a bread inlet to the primary stage of the cooler, and then passing the bread through the secondary stage of the cooler to further cool and condition the bread by passing an air stream through the secondary stage.

In one embodiment the air for the primary stage of the cooler is obtained by passing ambient air through a humidifier adjacent an air inlet to the primary stage, controlling operation of the humidifier to regulate the humidity of the air delivered through the primary stage.

In another embodiment the air for the primary stage is obtained by mixing a quantity of air exhausted from the primary stage with a further quantity of ambient air in a controlled manner upstream of the humidifier.

In a further embodiment the air stream for the secondary stage of the cooler is obtained by passing ambient air through the secondary stage.

In another embodiment the process includes the step of separately supplying ambient air to the primary stage and to the secondary stage of the cooler and separately exhausting the air from the primary stage and the secondary stage of the cooler.

In a further embodiment the process includes the step of blowing air onto the dough pieces as they are being conveyed from the dough divider to the dough piece moulding machine in a controlled manner to form a thin outer skin on an exterior of each dough piece prior to delivery of the dough piece to the moulding machine.

Ideally the air is blown onto the dough pieces by delivering air to air manifolds extending along each side of a conveyor carrying the dough pieces between the dough divider and the moulding machine, each air manifold having one or more air outlets for directing air at dough pieces passing along the conveyor.

In another embodiment the process further includes taking hot tins from which baked bread has been removed downstream of the oven, passing the hot tins through a tin cooler and then to a greasing station at which an interior of each tin is coated with grease and then delivering the greased tins to the tinning station for re-use.

Preferably the process includes conveying the tins between the oven and the tinning station on a tin carrying conveyor, and upstream of the greasing station moving each tin onto a tin cooling carousel which carries the tin in air for a preset cooling time between an inlet and an outlet of the carousel, moving the tin back onto the tin conveyor at the outlet of the carousel.

In a further embodiment the process includes the step of mixing the quantities of ingredient materials including flour, yeast and water to produce the batch quantity of dough at a preset desirable temperature by calculating the heat content of the flour and the yeast ingredients and then adding water having the balance of the heat content required.

In another embodiment the process includes the step of spraying steam onto the tops of the dough pieces in the tins at a stream injection station immediately prior to delivery of the tins through the oven, and delivering waste hot air from the steam injection station to the final prover to at least partially condition the air in the prover to the preset desirable temperature and humidity values.

In another aspect the invention provides apparatus for carrying out the process, the apparatus including a bread cooler having a bread inlet and a bread outlet with a conveyor to carry the bread between the bread inlet and the bread outlet, the cooler being of two-stage construction having a primary stage and a secondary stage through which the conveyor passes, means for passing a high-volume of cooling air having a relatively high humidity through the primary stage, and means for passing a separate air stream through the secondary stage.

Preferably a humidifier is provided for the primary stage mounted across an air inlet to the primary stage, means being provided for passing ambient air through the humidifier to provide the cooling air.

In another embodiment the cooler has an inlet air duct and an exhaust air duct and an air recirculating duct interconnecting the inlet air duct and the exhaust air duct, valve means being provided on the air recirculating duct to control air flow through the air recirculating duct.

Preferably the secondary stage is connected to an ambient air supply.

Ideally the primary stage and the secondary stage have separate air supply means and air exhaust means.

In a further embodiment the apparatus includes a conveyor for delivering dough pieces from the dough divider to the moulding machine, and an air distributor mounted adjacent the conveyor for blowing air onto the dough pieces carried on the conveyor.

In a particularly preferred embodiment the air distributor comprises a pair of air manifolds mounted along each side of the conveyor, each air manifold connected to an air supply and having a plurality of spaced-apart air discharge outlets for directing air at dough pieces carried on the conveyor.

In a further embodiment the apparatus includes a tin cooler having a carousel with a number of spaced-apart trays for reception of tins, means for loading tins on a tray at an inlet of the carousel, means for discharging tins from a tray at an outlet of the carousel, and means for conveying the trays between the inlet and the outlet of the carousel.

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only, with reference to the accompanying drawings in which:-

Fig. 1 is a diagrammatic illustration of a bread baking process and apparatus according to the invention;

Fig. 2 is a diagrammatic illustration of a bread cooler forming portion of the bread baking apparatus used in the process;

Fig. 3 is a perspective view of portion of the bread baking apparatus used in the process;

Fig. 4 is a side elevational view of the apparatus shown in Fig. 3;

Fig. 5 is a sectional view taken along the line V-V of Fig. 4;

Fig. 6 is an elevational view of a tin cooling carousel forming portion of the bread baking apparatus used in the process; and

Fig. 7 is a plan view of the tin cooling apparatus.

Referring to the drawings a bread baking process and apparatus according to the invention will be described. Firstly, measured quantities of ingredient materials, consisting primarily of flour, yeast and water are delivered to a dough mixer 10 and mixed to form a batch quantity of dough. The flour is normally stored at ambient temperature and the yeast is typically kept at a temperature of 6°C. Water can be supplied from a filtered mains water supply, from a chilled water supply -

typically at 4°C - or from a hot water supply. The temperatures of the flour and yeast are sensed and the heat content of the flour and yeast are calculated. A mixture of water from the various water supplies is then added to the mixer 10 to provide a balance of the heat necessary such that the dough, when mixed, is at a desired dough temperature, typically 29.5°C.

The batch of dough is delivered from the dough mixer 10 to a dough divider 12 which divides the dough into dough pieces of a preset desirable size e.g. 800g. The dough is divided on a volume basis and it is thus important to keep the temperature of the dough discharged from the mixer at the preset temperature to maintain accuracy. Advantageously this is readily easily achieved in the manner described above.

Dough pieces are conveyed on a conveyor 14 from the divider 12 to a dough piece moulding machine 16 in which the dough pieces are shaped into balls of dough. The dough moulding machine may conveniently be a conventional type of conical dough moulding machine. The balls of dough discharged from the moulding machine 16 are arranged on trays and delivered through an initial prover 18. As the dough pieces pass through the prover 18 the temperature and humidity of air within the prover 18 is maintained at preset desirable values. In this case the temperature is in the order of 35°C and the relative humidity is 80%. The transit time through the prover 18 is approximately 3 minutes.

Downstream of the prover 18 the dough pieces are passed through a panner-moulder 20 in which each dough piece is flattened and then rolled and split into four segments prior to dropping the dough piece into a tin at a tinning station 22.

The tins are then delivered through a final prover 24, the air within the final prover being maintained at a preset desirable temperature and humidity during through passage of the tins. In this case the temperature is in the region 35 - 40°C and the relative humidity is typically 80 - 90%. Transit time of the dough through the final prover is typically 58 minutes.

Downstream of the final prover 24 the tins containing the dough are conveyed through a continuous oven 26 to bake the dough at a preselected temperature for a preset time period to form bread loaves. Optionally, upstream of the oven 26, steam may be sprayed onto the tops of the dough in the tins at a steam injection station 28 immediately prior to delivery of the tins through the oven. Advantageously, waste hot air from the steam injection station 28 may be delivered to the final prover 24 to at least partially condition the air in the final prover 24 to the desirable temperature and humidity values.

Tins containing the bread loaves are discharged from the oven 26 and at a tin remover 30 the bread loaves are automatically lifted out of the tins which are recirculated back to the tinning station 22 via a tin cooler 32 and tin greaser 34.

The bread removed from the tins is delivered into a bread cooler 36 and thereafter optionally to a bread slicer 39 and/or bread wrapper 40.

The bread cooler 36 is shown in more detail in Fig. 2. The bread cooler 36 comprises a two-stage cooler having a primary stage 42 comprising an elongate chamber mounted above a secondary stage 43 formed by a similar elongate chamber. A dividing wall 44 separates the primary stage

42 and secondary stage 43. Bread loaves enter at a bread inlet 45 at one end of the primary stage 42 and are mounted on a conveyor which travels along the primary stage 42. On reaching the end of the primary stage 42 the conveyor passes downwardly through an opening 47 into the secondary stage 43 and then moves back along the secondary stage 43, bread being discharged at a bread outlet 46 adjacent the bread inlet 45. Suitable bread conveying apparatus for carrying the bread through the cooler 36 between the bread inlet 45 and the bread outlet 46 is well known and is therefore not described. A separate air supply is provided for each stage 42, 43 of the cooler 36. A primary air inlet duct 48 delivers ambient air through a humidifier 49 and through the primary stage 42, a fan (not shown) at an outlet end of the humidifier moving the air through the primary stage 42. A suction fan 50 is also provided at an outlet end of the primary stage 42 for discharging the air through a primary exhaust air duct 51. An air recirculating duct 52 interconnects the exhaust duct 51 with the primary air inlet duct 48, flaps 53, 54 being provided for controlling the amount of air recirculated. It will be noted that a high volume of cooling air is passed through the primary stage at relatively high humidity (typically in the order of 80% relative humidity) the cooling air inlet being provided adjacent the bread inlet 45. When the temperature of the ambient air drawn into the primary stage 42 is very low, for example, during winter time the flaps 53, 54 on the air recirculating duct 52 may be operated to recirculate some of the air from the exhaust air duct 51 to the primary air inlet duct 48 for mixing a quantity of the exhaust air, which will have been heated by the bread, with a quantity of the incoming ambient air. Thus, advantageously the temperature of the cooling air passed through the primary stage 42 can be readily easily and accurately controlled for optimum bread cooling

conditions. Advantageously, by exposing the incoming bread to a large volume of cold air this gives the bread a crispy and solid exterior which is good for slicing and for improved shelf life. Further, advantageously there is less moisture loss from the bread during the cooling process.

A separate ambient air supply is delivered through the secondary stage 43 via an air inlet duct 57 and an air outlet duct 58 at each end of the second stage 43. A suction fan 59 at an outlet end of the secondary stage 43 moves the ambient air through the secondary stage 43.

As the bread moves between the bread inlet 45 and bread outlet 46 its core temperature is cooled from a temperature in the region of 90 - 95°C to a temperature in the region of 17 - 27°C. It will be noted that the air pressure in both stages 42, 43 of the cooler 36 are substantially equal so that air migration between the two stages 42, 43 of the cooler 36 is minimized.

Referring now in particular to Figs. 3 to 5. Preferably as the dough pieces are being conveyed from the divider 12 to the moulder 16 along the conveyor 14 air is blown onto dough pieces 70 by an air distributor in a controlled manner to form a thin outer skin on an exterior of each dough piece 70 to facilitate handling and balling in the moulder 16. Air is delivered from an air supply to a pair of elongate tubular air manifolds 72, 73 mounted adjacent the conveyor 14 and extending along each side of the conveyor 14. Each manifold 72, 73 has a number of spaced-apart air outlet holes 75 to distribute air in an envelope around the dough pieces 70 as they pass along the conveyor 14 to form a thin outer skin on the dough pieces 70.

The conveyor 14 is in two parts comprising a feed portion 78 carrying the dough pieces 70 side-by-side from the divider 12. A snatch conveyor 79 travelling at a faster speed than the feed conveyor 78 collects each dough piece 70 in turn from the feed conveyor 78 for delivery to the moulder 16. As the snatch conveyor 79 is moving more quickly than the feed conveyor 78 the dough pieces 70 are thus conveniently spaced-apart prior to delivery to the moulder 16.

Referring now in particular to Figs. 6 and 7. When the hot tins from the oven 26 are emptied in the tin remover 30 they are recirculated back to the tinning station 22 for re-use. The tins are typically at a temperature of 125 - 130°C and ideally need to be reduced in temperature to less than 50°C and preferably to approximately 40°C prior to delivery to the greasing station 34. To cool the tins the invention advantageously provides a tin cooling carousel 80 which forms the tin cooler. This carousel 80 is mounted adjacent a conveyor 81 bringing the hot tins from the oven 26 and having mounted directly above it adjacent the carousel 80 a second conveyor 82 for carrying cooled tins to the tin greaser 34. The carousel 80 has a pair of spaced-apart endless chains 84 each circulated around four sprockets 86 spaced-apart on a support frame 87. An associated pair of sprockets 86 is mounted on a common shaft which is rotatably supported at each corner of the frame 87, each sprocket 86 carrying one of the chains 84. A drive motor 85 drives one pair of sprockets 86 through a chain or belt drive. Suspended between the two chains 84 are a number of spaced-apart trays 88 for reception of tins. Each tray 88 is rotatably mounted at each end to one of the chains 84 by pivot mountings 95 so the trays 88 are horizontally suspended between the chains 84 at all times.

In use, a number of tins are brought along the conveyor 81 and stopped adjacent the carousel 80. A pusher 89 pushes the tins onto a tray 88a adjacent the conveyor 81. Simultaneously directly above the tray 88a a batch of cooled tins is discharged from a tray 88b onto the conveyor 82 by another pusher 90. The chain 84 is then rotated in direction of arrow A to align the empty tray 88b with the lower conveyor 81 for reception of a new batch of hot tins while above it a batch of cooled tins is discharged onto the conveyor 82 by the pusher 90. The hot tins progress around the carousel 80 in the direction of arrow A allowing the tins to cool in ambient air. Typically the tins are on the carousel 80 for approximately 5 minutes. It will be appreciated that very little power is required to circulate the chain 84 and trays 88.

It will be appreciated that the process according to the invention provides a number of improvements directed towards minimising production time and cost and optimising efficiency and operational reliability whilst maintaining and improving product quality. This is achieved by carefully controlling the temperature and humidity of the dough and the bread at each stage of the process and by the efficient utilisation of waste energy.

The invention is not limited to the embodiments hereinbefore described which may be changed in construction and detail.

CLAIMS

1. A bread baking process comprising the steps of:-

(a) delivering measured quantities of ingredient materials to a dough mixer and mixing the ingredient materials to form a batch quantity of dough;

(b) delivering the dough to a dough divider and dividing the batch quantity of dough into dough pieces of a preset desirable size;

(c) conveying the dough pieces to a dough piece moulding machine and shaping each dough piece in the moulding machine;

(d) discharging the dough pieces from the moulding machine to an initial prover, maintaining the prover at a preset desirable temperature and humidity during through passage of the dough pieces;

(e) passing the dough pieces through a panner-moulder and discharging each dough piece into a tin at a tinning station;

(f) delivering the tins through a final prover, maintaining air within the final prover at a preset desirable temperature and humidity during through passage of the tins;

(g) conveying the tins through an oven to bake the dough at a preselected temperature for a preset time period to form bread loaves;

(h) removing the bread from the tins downstream of the oven; and

(i) cooling the bread by passing the bread through a two-stage cooler having a primary stage and a secondary stage, rapidly cooling the bread in the primary stage of the cooler by passing a high volume of cooling air at relatively high humidity through the primary stage, a cooling air inlet being provided adjacent a bread inlet to the primary stage of the cooler, and then passing the bread through the secondary stage of the cooler to further cool and condition the bread by passing an air stream through the secondary stage.

2. A bread baking process as claimed in claim 1 wherein the air for the primary stage of the cooler is obtained by passing ambient air through a humidifier adjacent an air inlet to the primary stage, controlling operation of the humidifier to regulate the humidity of the air delivered through the primary stage.

3. A bread baking process as claimed in claim 1 or claim 2 wherein the air for the primary stage is obtained by mixing a quantity of air exhausted from the primary stage with a further quantity of ambient air in a controlled manner upstream of the humidifier.

4. A bread baking process as claimed in any preceding claim wherein the air stream for the secondary stage of the cooler is obtained by passing ambient air through the secondary stage.

5. A bread baking process as claimed in any preceding claim including the step of separately supplying ambient air to the primary stage and to the secondary stage of the cooler and separately exhausting the air from the primary stage and the secondary stage of the cooler.

6. A bread baking process as claimed in any preceding claim wherein the process includes the step of blowing air onto the dough pieces as they are being conveyed from the dough divider to the dough piece moulding machine in a controlled manner to form a thin outer skin on an exterior of each dough piece prior to delivery of the dough piece to the moulding machine.

7. A bread baking process as claimed in claim 6 wherein the air is blown onto the dough pieces by delivering air to air manifolds extending along each side of a conveyor carrying the dough pieces between the dough divider and the moulding machine, each air manifold having one or more air outlets for directing air at dough pieces passing along the conveyor.

8. A bread baking process as claimed in any preceding claim wherein the process further includes taking hot tins from which baked bread has been removed downstream of the oven, passing the hot tins through a tin cooler and then to a greasing station at which an interior of each tin is coated with grease and then delivering the greased tins to the tinning station for re-use.

9. A bread baking process as claimed in claim 8 including conveying the tins between the oven and the tinning station on a tin carrying conveyor, and upstream of the greasing station moving each tin onto a tin cooling carousel which carries the tin in air for a preset cooling time between an inlet and an outlet of the carousel, moving the tin back onto the tin conveyor at the outlet of the carousel.

10. A bread baking process as claimed in any preceding claim including the step of mixing the quantities of ingredient materials including flour, yeast and water to produce the batch quantity of dough at a preset desirable temperature by calculating the heat content of the flour and the yeast ingredients and then adding water having the balance of the heat content required.

11. A bread baking process as claimed in any preceding claim including the step of spraying steam onto the tops of the dough pieces in the tins at a stream injection station immediately prior to delivery of the tins through the oven, and delivering waste hot air from the steam injection station to the final prover to at least partially condition the air in the prover to the preset desirable temperature and humidity values.

12. A bread baking process substantially as hereinbefore described with reference to the accompanying drawings.

13. Bread whenever produced by the process as claimed in any preceding claim.

14. Apparatus for carrying out the process as claimed in any of claims 1 to 12 including a bread cooler having a bread inlet and a bread outlet with a conveyor to carry the bread between the bread inlet and the bread outlet, the cooler being of two-stage construction having a primary stage and a secondary stage through which the conveyor passes, means for passing a high-volume of cooling air having a relatively high humidity through the primary stage, and means for passing a separate air stream through the secondary stage.

15. Apparatus as claimed in claim 14 wherein a humidifier is provided for the primary stage mounted across an air inlet to the primary stage, means being provided for passing ambient air through the humidifier to provide the cooling air.

16. Apparatus as claimed in claim 14 or claim 15 wherein the cooler has an inlet air duct and an exhaust air duct and an air recirculating duct interconnecting the inlet air duct and the exhaust air duct, valve means being provided on the air recirculating duct to control air flow through the air recirculating duct.

17. Apparatus as claimed in any of claims 14 to 16 wherein the secondary stage is connected to an ambient air supply.

18. Apparatus as claimed in any of claims 14 to 17 wherein the primary stage and the secondary stage have separate air supply means and air exhaust means.

19. Apparatus for carrying out the process as claimed in any of claims 1 to 12 including a conveyor for delivering dough pieces from the dough divider to the moulding machine, and an air distributor mounted adjacent the conveyor for blowing air onto the dough pieces carried on the conveyor.

20. Apparatus as claimed in claim 19 wherein the air distributor comprises a pair of air manifolds mounted along each side of the conveyor, each air manifold connected to an air supply and having a plurality of spaced-apart air discharge outlets for directing air at dough pieces carried on the conveyor.

21. Apparatus for carrying out the process as claimed in any of claims 1 to 12 including a tin cooler having a carousel with a number of spaced-apart trays for reception of tins, means for loading tins on a tray at an inlet of the carousel, means for discharging tins from a tray at an outlet of the carousel, and means for conveying the trays between the inlet and the outlet of the carousel.

22. Apparatus substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
GB 9302747.2

Relevant Technical fields

(i) Int Cl (Edition L) A2A:A1 A2B:BMB11;BMB39;BKC;BKW F4H

(ii) Int Cl (Edition 5) A21B; A21C; F25D

Search Examiner
B J GARDNER

Databases (see over)
(i) UK Patent Office

(ii) NONE

Date of Search
27 MAY 1993

Documents considered relevant following a search in respect of claims 1 - 22

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2156501 A (BAKER PERKINS HOLDINGS plc) see particular page 2 lines 69 & 86	14 and 15 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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